(calculated vs. measured) within ±2%. For that tuning task, isocenter dose measurements in a polystyrene phantom were compared to the calculated ones for five IMRS stereotactic plans. Three correction values to the factory DLG value were analyzed: 0.0, -0.25 and -0.5 mm. Accuracy of the M3D software to reproduce the penumbra of stereotactic fields was investigated by comparing the profiles measured in water with the calculated ones for a 1x1 cm^2 MLC-collimated field size. Twelve cranial IMRS plans calculated using the Eclipse were retrospectively recalculated using the Mobius3D software (version 1.3). The same monitor units and calculation voxel sizes (1 mm) were used for both systems. The aperture (complete irradiation area outline) of the modulated beams ranged from 0.9 to 4.4 cm^2 . Differences between both algorithms were evaluated using the 3D gamma tool available in the M3D system. Gamma passing rates for the target and organs at risks (OARs: brainstem, chiasm, optic nerves and normal brain tissue) were compared for 3%/1 mm, 3%/2 mm and 5%/1 mm criteria.

Results:

1) Differences (M3D vs. measured) within 1 mm were found for the penumbras of the 1x1 cm^2 field.

2) Dose differences of 2.7% (SD: 1.6%), 1.5% (SD: 1.9%) and 0.4% (SD: 2.0%) were found for the DLG correction values of 0.0, -0.25 and -0.5 mm, respectively.

3) Using the optimal DLG correction (-0.5 mm), the target 3D gamma passing rates were: 94% (73-94%), 97% (80-100%) and 100% (97-100%) for the 3%/1 mm, 3%/2 mm and 5%/1 mm criteria, respectively. 100% rates were obtained for all OARs regardless of the gamma criterium.

Conclusions: Great agreement was obtained (within 5% and 1 mm) between IMRS plans calculated by the Eclipse and by the independent dose calculation software M3D. Our findings are restricted to small field sizes down to 1x1 cm^2 . The M3D software may be proposed as an alternative to patient-specific QA based on measurements for IMRS plans.

EP-1425

Frameless linac based radiosurgery of arteriovenous malformations: geometrical accuracy

R. Tijssen[1], A.N.T. Kotte[1], A.J.M. Wopereis[1], E. Brand[1], C.J.M. Klijn[2], G.A.P. De Kort[3], J. Berkelbach[3], W.S.C. Eppinga[1], E. Seravalli[1]

[1]*UMC Utrecht, Department of Radiation Oncology, Utrecht, The Netherlands*

[2]*UMC Utrecht, Department of Neurosurgery, Utrecht, The Netherlands*

[3]*UMC Utrecht, Department of Radiology, Utrecht, The Netherlands*

Purpose/Objective: To assess the geometrical accuracy, by an end-to-end test, of frameless linac based radiosurgery of brain arteriovenous malformations (AVMs).

Materials and Methods: Throughout the treatment chain (angiography, CT imaging, and stereotactic radiotherapy) a three point thermoplastic head mask is used, which replaces the invasive stereotactic frame. The angiographic and CT images are co-registered by means of six conventional skin markers, which are placed on the mask. An anthropomorphic skull phantom (Accuray, Inc.) was used to perform the end-to-end test. The phantom has an insert with a spherical target in the center which can hold two orthogonal Gafchromic films. The films are tightened by four notches at each axial and sagittal plane. The CT coordinates of these notches were used to register the film during analysis. The accuracy of the CT to angiography (projection) registration was assessed based on the markers deviation. The shift required to align the film measured dose with the calculated one was attributed to be the targeting error. Moreover, brain radiosurgery (SRS) patient data were analyzed to determine the uncertainty introduced by movement of the patient within the mask upon repositioning between the angiography and the CT scan sessions. The overall geometrical accuracy of the treatment chain is obtained combining these uncertainties.

Results: Angiography to CT registration was performed with subvoxel accuracy. The targeting accuracy of the frameless radiosurgery AVMs treatment chain was smaller than 1 mm for the three spatial directions and the two investigated linear accelerators. Patient data revealed a motion in the range of (0.70-1.5) mm and (0.6 – 1) degrees (absolute average) due to the repositioning of the mask between treatment sessions. Combining these uncertainties an overall geometrical accuracy of 1.5 mm is found.

Conclusions: Frameless linac based radiosurgery of AVMs is feasible with a geometrical accuracy comparable to the frameless linac based SRS treatment chain.

EP-1426

Target coverage: VMAT vs 3D in the treatment of lung cancer

M. Rincon Perez[1], J. Luna Tirado[1], S. Gomez-Tejedor Alonso[1], M.A. Garcia Castejón[1], J.M. Penedo Cobos[1], J.P. Marin Arango[1], A.M. Perez Casas[1]

[1]*IDC-Fundación Jimenez Díaz, Radiotherapy, Madrid, Spain*

Purpose/Objective: To compare the uniformity of the absorbed-dose distribution and the dose conformity of two different radiotherapy treatments for lung cancer: conformal 3D (3DCRT) and double-arc volumetric modulated arc therapy (VMAT)

Materials and Methods: 3DCRT and VMAT plans were optimized for 12 lung cancer patients. Treatment planning was performed using two treatment planning systems: XIO 4.80 for 3DCRT plans with superposition algorithm and Monaco 3.30.01, based on the Monte Carlo algorithm, for VMAT plans. For all patients, the target prescription dose was 60 Gy delivered in 30 fractions on an Elekta Synergy Beam Modulator linear accelerator equipped with 40 pairs of opposing leaves with 4mm thickeness at isocenter. 3DCRT plans consisted of 3-5 coplanar 6MV fields, while VMAT plans comprised two 6MV 360º arcs.

All the plans were considered to be clinically acceptable when at least 99% of the PTV volume received 98% of the prescribed dose and maximum dose was less than 107%. The constraints for the OAR included: volume of spinal cord receiving more than 45Gy < 10%, volume of heart receiving more than 45Gy < 45% and the V20 of lung minus PTV was set at < 35%.

The two techniques were compared in terms of target homogeneity, target conformity and irradiated volume of normal tissues. Target conformity was quantified using the conformity index (CI) defined by Paddick as:

$$CI_{Paddick} = \frac{TV_{PI}^2}{PI*TV}$$

where PI is the whole tissue volume receiving the prescribed dose, TV is volume of PTV y TV_{PI} is the target volume within the prescribed isodose volume.

A perfect plan would have TV_{PI} = TV = PI and yield a $CI_{Paddick}$ of 1.0.

Irradiated volume of normal tissue and dose gradient were analyzed by comparing the Paddick's gradient index (PGI) defined as

$$PGI = \frac{V_{50\%PI}}{PI}$$

where $V_{50\%PI}$ is the volume irradiated at 50% of the prescribed dose.

The homogeneity index (HI) describes the dose uniformity within a target volume. Two definitions of HI were used: the definition suggested by ICRU Report 81 and the definition reported in the MONACO planning system.

$$HI_{ICRU81} = \frac{D_{2\%} - D_{98\%}}{D_{50\%}}$$

$$HI_{MONACO} = \frac{D_{5\%}}{D_{95\%}}$$

An HI_{ICRU81} of 0 y HI_{MONACO} of 1 indicates that the absorbed-dose distribution is almost homogeneous.

Results: Table 1 summarizes the result of each index (mean ± standard deviation (SD)).

VMAT plans had a better conformity ($p < 0.001$) and produced the best dose homogeneity compared with 3DCRT plans ($p < 0.01$ for HI_{ICRU81} and $p < 0.001$ for HI_{MONACO})

In addition, the volumes of normal tissues irradiated with a moderate dose (50% of the prescribed isodoses) were slightly lower in VMAT plan ($p < 0.001$)

	3DCRT	VMAT
$CI_{Paddick}$	0.52 ± 0.15	0.83 ± 0.04
HI_{ICRU81}	0.136 ± 0.051	0.088 ±.0.018
HI_{MONACO}	1.09 ± 0.02	1.07 ± 0.01
PGI	5.0 ± 0.8	4.3 ± 0.4

Conclusions: The quality of the absorbed-dose distribution, illustrated with two independent specifications, dose homogeneity and dose conformity, in a radiotherapy treatment for lung cancer, is better with a VMAT plan than with a conventional 3D plan. Utilizing conformity, homogeneity, and gradient index is very important in evaluating patient plans and should be used during planning.

EP-1427

VMAT vs. dynamic conformal arc technique in radiosurgery. A comparison of absorbed dose in the healthy brain tissue

M.A. Garcia Castejon[1], J.M. Penedo Cobos[1], A.M. Perez Casas[1], J. Olivera Vegas[1], M. Rincon Perez[1], S. Gomez Tejedor[1], J. Muniz Igneson[1], I. Prieto Munoz[1], R. Gonzalez Abad[1], J. Ayerbe Gracia[1], J. Vara Santos[1]

[1]Capio-Fundación Jimenez Díaz, Radiotherapy Oncology, Madrid, Spain

Purpose/Objective: The aim of this study was to evaluate and compare the Volumetric Modulated Arc Therapy (VMAT) and the Dynamic Conformal Arc (DCA) techniques for the treatment of brain metastasis and their influence on the absorbed dose by the healthy brain tissue (HBT).

Materials and Methods: Fourteen patients with one or two brain metastasis were treated using a Monacotreatment planning system with Monte Carlo Algorithm (version 3.30.01), using 6MV photon beams generated from Elekta Synergy Beam Modulator Linac. 10 patients (71 %) had one target. VMAT and DCA treatment plans were created for every patient using a single isocenter and multi-arc non-coplanar technique. The prescription doses ranged from 12-22 Gy in a single fraction. All planning objectives for PTV and organs at risk (OAR) were in accordance to those used in QUANTEC protocol for a single dose of radiation. Each plan was normalized to deliver 100% of the prescription dose to 100% of the target volume.

In each patient PTV, OAR and HBT were contoured in order to evaluate the received doses.

Treatment plans were compared to know the biological equivalent doses (BED) received in the HBT: $V(5_{BED}Gy)$ and $V(10_{BED}Gy)$. Conformity Index (CI_{RTOG}), Homogeneity Index (HI_{RTOG}), the maximum absorbed doses to OAR, the numbers of arcs, total monitor units (MU) and delivery treatment time (DTT) were also compared.

Results: $V(5_{BED}Gy)$ and $V(10_{BED}Gy)$ were lower for VMAT compared with DCA plan (difference of 20.5%, $p<0.001$ and 20%, $p<0.005$ respectively). There were no significant differences between both techniques for OAR sparing ($p>0.1$). VMAT plans showed a lower mean CI_{RTOG} and HI_{RTOG}compared with the DCA plans (difference of 37.1%, $p<0.001$ and 3.5%, $p<0.001$ respectively). The numbers of arcs were also lower in VMAT plans compared with DCA plans. Although mean MU per fraction was higher for VMAT (an increase of 35%, $p<0.001$), the mean DTT using VMAT was slightly shorter than using DCA (2.2 min on average for 12 Gy prescription), (Table1).